

AGRICULTURAL EQUIPMENT NEEDS OF AFRICA

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CURRENT STATE OF MECHANIZATION

Numbers of implements in use in Africa are usually estimated from rural development project reports. Table 1 gives estimations, from CEEMAT studies, of animal draft implements in 11 African countries.

Animal draft implements

Mechanization with animal power mainly concerns soil preparation (plows, cultivators, ridgers), weed control, and transport. Planters were first used for groundnuts and then for maize; some drills for rice seeding are being distributed. These implements are first adapted for rainfed farming and can be used with oxen, horses, and donkeys. There is no draft harvesting implement except the groundnut lifter in Senegal. Hand (ultralow volume) sprayers are widely used in cotton production in francophone countries.

African farmers prefer single-purpose tools over multipurpose implements, given financial resources.

Distribution of implements depends on many factors:

- historical introduction (Guinea),
- traditional know-how (plowing in Mali),
- weed control priority (plowing in Ivory Coast or Senegal),
- long-term extension service influence (sowing in Senegal),
- soil conditions (cultivators and sand soils), and
- size of area (hydro-agricultural parceling in Niger).

Ratios of equipment available to area served are not usually meaningful; with animal draft equipment, observed ratios often exceed calculated ones. For instance:

- South of Mali: 6 ha/plow (cotton area)
- Senegal: 2-4 ha/planter according to climatic zone
1.5-2.7 planters/family in groundnut area
1.5-2.7 hoes/family in groundnut area
- Niger and Burkina Faso (Upper Volta): less mechanized than Senegal or Mali but 1 cultivator/production unit is the ratio in some schemes.
- Whenever a farmer can, he buys a cart.

Table 1. Animal draft implements in some African countries.

Country	Implements (no.)					
	Planters	Hoes	Carts	Plows	Ridgers	Lifters
Senegal	145,000	228,000	101,000	52,000	8,900	67,000
Mali	11,000	55,000	52,000	107,000	—	—
Ivory Coast	—	9,000	4,000	—	—	—
Niger	3,000	14,200	19,000	8,500	2,300	6,000
Burkina Faso	—	31,000	26,000	29,000	15,000	—
Benin	—	10,100	5,600	—	—	2,000
Mozambique	—	—	—	36,000	—	—
Ghana	—	—	—	6,000	—	—
Cameroon	—	—	—	25,700	—	—
Tchad	—	5,800	19,000	79,000	5,800	—
Madagascar	—	41,000	126,000	162,000	—	—

Equipment use exceeds standards when animal draft cultivation reaches a level that is part of the way of life. In Guinea, plows are used after many years without extension services — the plow has become a traditional tool. Then, implements are borrowed or rented extensively among farmers; differences between levels of mechanization tend to disappear and field work requires hand tools as well as draft equipment. This is the process in Senegal and Mali.

Draft cultivation generally increases productivity of human labor and increases the area cultivated. A recent survey in Ivory Coast gives data illustrating this. Two parallel scales show the progression between amount of human and animal work needed in extensive and intensive situations when cultivating 1 ha:

- from 10 to 70 h of animal work to cultivate 1 ha
- from 60 to 150 d/ha of human complementary work in a highly intensive system.

The survey showed a maximum of 1.15-1.20 ha/labor unit with hand tools and 1.20-1.27 ha/labor unit with animal-drawn equipment.

Motorized agriculture

Even a simple description of motorized agriculture has to distinguish between pre-mediterranean countries plus South Africa, and countries south of the Sahara. Here are tractor numbers for countries in these two groups:

South Africa	200,000 (1980)	Nigeria	8,000 (1980)
Egypt	34,500 (1984)	Kenya	7,500 (1982)
Algeria	43,700 (1980)	Ivory Coast	2,500 (1982)
Morocco	24,500 (1980)	Zaire	3,500
Sudan	7,600 (1984)		

In Algeria, Egypt, and Morocco, from 3,000 to 5,000 combines are in use.

Government ownership presents more problems than private ownership, including technical choice, profit-earning capacity, and servicing difficulties. That traditional farmers are rarely involved may explain many failures.

Equipment ownership in the private sector depends largely on cash crops or monetary flow between main towns and villages. For instance, more than half of the 4-wheel tractors in Ivory Coast are located in the forest zone, paid for by producers of banana, coffee, cacao, and pineapple. Tractors are used for tillage, weed control, spraying, and transport. In some countries, such as Zaire, tractors are used for nonagricultural transport.

Nonconventional motorized agriculture (intermediate technology)

Many countries have been thinking of intermediate technology since the seventies: Europe, United States, the Philippines (IRRI), and French- and English-speaking countries in Africa.

CEEMAT has no bias toward forms of power and implements, whether human hand tools, animal-powered implements, or motorized equipment such as tractors. The motorized equipment chosen in West Africa were intended to

- allow the agricultural upper class (large availability of land and labor) to proceed beyond the limits of animal power, and
- answer the humid country problem of diseases making animal power impossible.

Intermediate motorization (Tractor Bouyer TE-20hp) began in 1977 in six countries: Senegal, Mali, Burkina Faso, Ivory Coast, Cameroon, and Chad. Concurrently, the tractor Tinkaby (hydraulic transmission) was introduced in Swaziland.

CEEMAT observed that TE tractor use by 1985 totaled 853; 109 in Burkina Faso, 463 in Ivory Coast, 77 in Mali, and 204 in Cameroon. Ten tractors were irreversibly damaged. At the beginning (1977-80) the tractor was essentially a prototype and many mechanical problems had to be solved. Operating costs were high.

Tractors are bought directly by farmers in Burkina and Mali, and by groups of farmers in Ivory Coast. A hiring system is established in Cameroon. Most use is in cotton production, with programs to improve farmer knowledge and tractor maintenance.

Tractors and implements are bought on credit (6-7 yr, 9-10% interest). A down payment equal to the annual installment must be paid before delivery in Burkina and Mali.

Farm size varies from 20 to 25 ha in Ivory Coast and Burkina to 30+ in Mali. All farms use substantial human labor.

After 8 yr, these are the results:

- Cultivated area is stabilized around 1 ha/worker (more than 1 with motorized agriculture, less than 1 or about 1 with animal draft agriculture). Farm size has increased little.
- Type of work is similar with tractor or animals, but tractor use is 3-6 times more efficient, is more timely, and allows incorporation of manure or straw into soil.
- Farmers keep animals for weed control, ridging (cotton, maize), and to plow out stocks and roots. They usually hire out their animals rather than their tractors.

- Tractor use seems economical, with costs balanced by income from increased crop production.
- Training and maintenance are easy; farmers learn quickly.

CRITICAL NEEDS TO INCREASE PRODUCTIVITY OF SMALLHOLDINGS

Crop harvesting is still largely unmechanized. Manual harvesting is slow, increasing crop losses. With rural depopulation, even in Sahelian countries, the labor supply is decreasing and cost is rising (example: palm-tree harvesting in Ivory Coast). When intensification is successful, labor peaks increase.

Farmers and consumers are concerned about postharvest losses. Storing and drying remain priorities for research and training.

With tuber crops such as cassava, processing into food products is traditional and difficult to valorize. This is why research concerning processing of tuber crops is a priority for CIRAD and CEEMAT.

For decades, research and extension organizations put all their effort into cash crops (groundnut, cotton, maize, etc.). As a result, these crops are partially mechanized. Cereal crops need similar attention from sowing to harvesting, and tuber crops from tillage to harvesting.

The high cost of energy increases the production cost of many underdeveloped countries. For example, in 7 yr in West Africa, the quantity of cotton fiber needed to pay for one liter of diesel fuel has increased two to three times. Even intensification in modern agricultural countries cannot respond to such increases.

Therefore, research for alternative energy is a priority. Results look good for gasification for stationary engines, and for liquid substitution of diesel fuel by oil or alcohol for tractors and cars.

Survey of needs

In 1980-81, CEEMAT and SEDES surveyed need for agricultural mechanization in African countries north of the equator. The survey involved these stages:

- identification of homogeneous zones (soil, climate), rural and ethnic population, density of population, crops, etc.;
- farming system analysis in every zone;
- mechanization approach and problems in each zone;
- identification of solutions through machines in use or through innovations; descriptions of these innovations;
- typology of units of production;
- analysis of political decisions concerning mechanization in each country; and
- socioeconomic analysis in each case.

This study covers agricultural needs, but market capacity also needs attention. Table 2 gives the estimated needs for agricultural implements in 15 countries for 10 yr beyond the 1980-81 survey.

Table 2. Need for agricultural implements in 10 yr in Egypt, Morocco, Algeria, Tunisia, Central African Republic, Guinea, Niger, Senegal, Burkina Faso, Togo, Cameroon, Nigeria, Ivory Coast, Mali, and Benin.

Implements	No.
Animal draft implements	340,000
Two-axle tractors	78,700
Intermediate motorization	40,000
Conventional motorization	17,300
Tractors for forest	25,000
Rice harvesting equipment	580,000
Tuber harvesting equipment	100,000
Cotton harvesting equipment	43,000
Fruit harvesting equipment	3,000
Small pumps	120,000

CONCLUSIONS

Studies and projects have provided better sociological and socioeconomic understanding of agricultural production units. Everyone notes differences between development objectives and reality: labor organization, motivations and priorities, time and space relationships, profit appreciation against vital needs. Mechanization is an answer to a country's specific characteristics and problems; it cannot follow another country's experience. Further, there is no appropriate technology apart from appropriate human development.

In West Africa, farmers always depend on projects and schemes. This permanent aid removes the farmer from voluntary effort. Experience in intermediate tractorization shows that farmers can succeed when they have responsibilities. Extension and training services must exchange information with farmers, not take the farmers' place in decision-making. Farmers need advisers in learning how to manage farm resources; they do not need controllers.

Whenever constraints to mechanization are analyzed, it is obvious that credit, marketing, farm product prices, and input costs have major importance. Mechanization constraints cannot be solved by technical proposals alone. The level of mechanization, for instance of tractor or oxen power, suitable for one zone will not necessarily fit another. There is no standard solution for underdeveloped countries in Africa or elsewhere.

Factories are producing agricultural implements in such African countries as Senegal, Mali, Ivory Coast, and Cameroon. Manufacturing animal draft equipment adds local value and can aid a country's trade balance. But this is not necessarily true of motorized equipment if it only involves local assembly of premounted elements. The system must also provide spare parts, training, and advice to farmers. Yet manufacturers are likely to be partners with development schemes and not with farmers. A decentralized system is important — from a central level providing scale economies to the village

blacksmiths, close to farmers. In countries where manufacture of implements ceased (Guinea, Senegal), blacksmiths proved they could supply spare parts and machines to farmers.

For intermediate technology to work, it requires intermediate levels of manufacture. Local manufacturers, including blacksmiths, need training, organization in steel supplying, additional tools and better quality materials, and perhaps improved access to credit.

The agricultural infrastructure and organization must meet the farmers' needs. The state, the development scheme, and the farmer are key factors of production. But the farmer needs professional association to defend his interest and create conditions for development. This lack of representation holds back agricultural modernization, and mechanization is the first victim.